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ULTRAHIGH-VACUUM DIFFUSION BONDING

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We have designed, constructed, and are operating an ultrahigh vacuum diffusion bonding machine aimed at preparing well controlled interfaces between similar and dissimilar materials. The machine provides control over interface topography (flat to 100 nm over 1 cm^2), crystallography (control to 0.1°), and chemistry (impurities below detectability limits using Auger electron spectroscopy). The machine currently comprises three chambers: annealing, surface analysis, and diffusion bonding. Using this machine, we have produced heterophase interfaces in the systems: Cu/sapphire, Au/sapphire, and Al/sapphire. We have also produced bicrystals of Nb, Cu, Al, Ta, Ni_3Al, YAG, and Cu/sapphire. A fourth chamber is under construction to facilitate preparation of interfaces with controlled impurities. In this presentation, we describe the machine and give examples or research that has been carried out which would not have been possible otherwise.

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